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STUDY OF THE TRILITES FORMGENUS IN LOWER CRETACEOUS DEPOSITS

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Introduction

A significant part of the Lower Cretaceous deposits in Hungary are to be found in the two mountain ranges of the Transdanubian Chain, the Bakony and the Gerecse. In the course of our palynological studies we have treated a Barremian grey sandstone complex from the borehole at Bikol in the Gerecse, and samples of the Albian stage layers from the boreholes Pe—31, Hk—4 and Ba—237 in the Bakony. The overwhelming majority of the sporomorphae found was trilete fernspore. In the present work we undertake the morphological elaboration of the most abundant of these spore-groups. On the basis of the artificial system these spores had to be classified among the *Trilites-Corrugatisporites-Lygodioisporites.* The examination of the palynological literature raises many nomenclature problems in connection with this question, and these are outlined below.

Nomenclature

1. Use of the *Corrugatisporites* fgenus

The name Corrugatisporites was first used by Thomson and PFLUG (1953), denoting the *Corrugatisporites solidus* (R. POT.) fsp. as the type of the genus. According to R. POTONIÉ (1956) the solidus fsp. can not be the type of the *Corrugatisporites* genus, because in 1951 he himself had put forward this name as the type of the *Lygodioisporites* fgenus, under the name *Lygodioisporites solidus* (R. POT.). In 1953 WEYLAND and GREIFELD described two Upper *Cretaceous* spores as *Corrugatisporites toratus* and *C. arcuatus,* attributing the name *Corrugatisporites* to IBRAHIM, although it is not due to him (POTONIÉ, 1956; *Krutzsch,* 1959). In his Synopsis, POTONIÉ (1956) gives a detailed description of *Corrugatisporites,* denoting the *C. toratus* WEYL. and GREIF fsp. as lectogenotype, while the name „solidus" formspecies is put forward as the type of the genus in the description of *Lygodioisporites* (POTONIÉ, 1951). KRUTZSCH (1959) mentions the *Corrugatisporites* genus as a synonym for the *Trilites* COOKSON 1947 ex COUPER 1953. In a later work, KRUTZSCH (1967, pp. 10—11) argues that the „toratus" form given by WEYLAND and GREIFELD can not be regarded as a lectotype, because it is a very heterogeneous form, with zonate conformations. In fact, the azonotrilete nature of this form is not obvious

from the given photographs and the deficient description. PLAYFORD and DETTMANN (1965) classify the *Corrugatisporites* in the *Duplexisporites* DEÁK 1962 genus, so that they emend the latter genus as belonging to the *Murornati*, although the *Duplexisporites* genus is definitely a cingulate one.

According to KRUTZSCH (1967) the fsp. „solidus" can be regarded as the lectotype of *Corrugatisporites*, which belongs, however, to the *Trilites* fgenus, because *Lygodioisporites* R. POT. is a valid name only since 1956, the 1951 name still being nomen nudum. Thus, in the view of KRUTZSCH, *Lygodioisporites* and *Corrugatisporites* can be regarded as later synonyms for *Trilites*, and the spores described in these two fgenera are to be classified in the *Trilites* genus. New forms have been described under the name *Corrugatisporites* by NILSSON (1958) and POCOCK (1970).

2. Use of the name *Trilites*

The name *Trilites* (ERDTMAN, 1947) was given a content by COOKSON (1947), with the description of several tertiary spores. COUPER (1953) classifies some New Zealand spore-forms in this genus, denoting *Trilites tuberculiformis* COOKSON 1947 as the type of the genus. POTONIÉ (1956) gives a brief description of this genus, emphasizing that the exines of the spores belonging here are densely ornamented with verrucae arranged polygonally to each other. KRUTZSCH (1959) gives the following definition of the *Trilites* genus:

„Azonotrilet Mikrosporen mit Skulpturelementen, die zu unregelmässigen Warzenzügen von verschiedener Höhe verschmolzen sind, aber keine ausgesprochen „positiven Reticuli" bilden, andererseits aber auch nicht mehr aus nur wenigen und umregelmässigen Verschmelzungen zweier benachbarter Zierelemente bestehen. Die Regel ist eine corrugate, z. T. etwas zu hamulaten, reticulatem u. a Habitus neigende Skulptur."

DETTMANN (1963) emended the genus after a reexamination of the *Trilites tuberculiformis* COOKSON 1947 fspecies. His diagnosis means a certain degree of narrowing-down of the *Trilites* genus to the forms close to *T. tuberculiformis*.

DETTMANN classifies among the *Trilites* those azonotrilete spores, the wall of which is differentially thickened, while the spores are more strongly thickened at their apices than on their faces, and in addition their contact area exhibits a straight or scabrate form, and their sculptural elements a verrucate or rugulate form, and they are anastomotic with each other. He states that the *Trilites* genus corresponds morphologically to the *Lygodioisporites* of POTONIÉ (1951), but of the two the *Trilites* has priority.

Results

A considerable proportion of the Hungarian Lower *Cretaceous* spores have the characteristics designated for the *Trilites genus*. The large number of fern-spores belonging to this group amount to about 30—40% of the spores found in the course of our investigations from the Barremian period. They are also very frequent in the Albian stage, amounting to 15—20% of the spores found here.

The common characteristics of these spores are as follows:

a) azonotrilete miosporae, with triangular or rounded-triangular equatorial contours, and rounded apices;

b) their sides are weakly convex, and rarely straight or concave;

c) the wall of the spores is differentially thickened, and because of the elevated ornamental elements on them the apices are more strongly thickened;

d) the proximal and the distal faces may also be ornamented; the contact area is straight or is provided with ribs bordering the laesurae torus-like, one to each; the distal surface may be verrucate, rugulate, corrugate or hamulate-like sculptured;

e) they probably belong to the *Schizaeales* order.

Since these spores are very close to the spores described in the *Trilites* (and the *Corrugatisporites* belonging here), both botanically and on the basis of the morphological system, we do not consider it justified to establish new genera, but with a resumé of the diagnoses given by POTONIÉ, KRUTZSCH and DETTMANN we propose the creation of the following three subformgenera:

I. *Trilites (Trilites)* n. subformgenus

II. *Trilites (Pereisporites)* n. subfgenus

III. *Trilites (Bikolisporites)* n. subfgenus

Detailed decription:

Trilites (ERDTMAN 1947, COOKSON 1947) ex COUPER 1953.

I. Subformgenus: *Trilites (Trilites)*

Type of the subformgenus: *Trilites (Trilites) tuberculiformis* COOKSON 1947.

Diagnosis: Azonotrilete miosporae, with triangular or rounded-triangular contours, rounded apices, and convex or straight sides. The wall is unevenly thickened, being thicker at the apices than at the sides. The proximal and distal sides are sculptured, with verrucate or rugulate, and rarely corrugate elements, but the contact area around the laesurae is straight or scabrate.

Forms occuring in the material:

1. *Trilites (Trilites) triangulus* KEDVES 1964 (Plate I, Figs. 1—4).

Syn.: 1964. *Trilites triangulus* n. fsp.
KEDVES (Pl. I, Figs. 7—9), Solymár, eocene (?) Hungary.

Description: *Azonotrilete* spores. The equatorial contour is triangular, with rounded apices, and straight or convex sides. The wall of the spore is very thick, 4—6 μ broad, and its surface is uneven from the irregularly elevated verrucae. The laesura is straight and simple, and extends to $^1/_2$—$^2/_3$ of the radius. The contact area is straight, and the other part of the proximal face is rugulate. The distal face is rugulate, and the sculptural elements are 3—4 μ broad and 2—2,5 μ high. Dimensions: 33—37 μ (in 20 specimens).

Note: According to a personal communication from KEDVES M., it is pro-

bable that the fsp. described by him is a form recycled through from the Lower Cretaceous.

Occurrence: (Gerecse mountains): Barremian. Bikol.

2. *Trilites (Trilites) asolidus* W. KR. 1959 (Plate I, Figs. 5—6).

Syn.: 1959b: *Trilites asolidus* n. fsp.
KRUTZSCH (Pl. 27 XXVII, Figs. 290—293), Geiseltal, mitteleozän.

1967. *Ischyosporites asolidus* (W. KR. 1959b) n. comb.
KRUTZSCH (Pl. XXI, Figs. 1—6). Bhg. Luckàn. m.-oligozän.

Note: According to the description, the form examined by us can be identified with the KRUTZSCH 1959b form.

In some specimens the sculpture was rather hamulate-like.

Occurrence: Balinka (Bakony mountains): Upper Albian.
Hárskut (Bakony mountains): Upper Albian.

3. *Trilites (Trilites) knaueri* nov. fsp. (Plate I, Figs. 7—8).

Derivatio nominis: in honour of the Hungarian geologist J. KNAUER.
Holotype: Bikol borehole, Prep.: Bi—6/3: 29,5—111,7.
Locus typicus: Bikol (Gerecse mountains): Barremian.
Stratum typicum: grey sandstone, 9,5—11,5 m.

Diagnosis: *Azonotrilete* spore. The amb is triangular, with rounded apices, and weakly convex or straight sides. The wall of the spore is very thick, and it is 5—6 μ broad at the sides, and 6—7 μ at the apices. The laesurae are thin, and weakly sinuous, and extend up to the wall of the spore. The contact area around the laesurae is straight, and extends to $^2/_3$ of the radius. The other parts of the proximal face are ornamented with large rugulate elements, and exhibit the same ornamentation as do the wall of the spore and the edge of the distal face.

3—4 ribs with corrugate ornamentation run on the distal face, and form an irregular triangle with each other.

Maximum dimensions: 45 μ (8 specimens).

Differential diagnosis: It differs from the other forms in the characteristic corrugate sculptura of the distal face, beside the straight contact area.

4. *Trilites (Trilites) hárskútensis* nov. fsp. (Plate I, Figs. 9—10).

Derivatio nominis: from the place of occurrence of the holotype.
Holotype: (Pl. I, Figs. 9—10) Prep. Bi—6/2: 43—107,2.
Locus typicus: Bikol (Gerecse mountains): Barremian.
Stratum typicum: grey sandstone, 9,5—11,5 m.

Diagnosis: *Azonotrilete* spore, with triangular contour, weakly convex sides, and slightly rounded faces. The laesurae are simple and straight, and extend up to $^3/_4$ of the equator. The contact area is straight only on the central $^1/_3$ part of the tetrad mark, while the other parts of the proximal face have a sinuous surface from the weakly elevated verrucae. The spore-wall is thick, and 3—6 μ broad, and the irregularly situated verrucae, which fuse into one another, are in places strongly elevated. The distal face is ornamented with rugulate elements. Maximum size: 56 μ.

Differential diagnosis: It differs from the other forms by the relatively homogenous nature of the distal face.

II. Subformgenus: *Trilites (Pereisporites)* nov. subformgenus

The type of the subformgenus: *Trilites (Pereisporites) minor* n. fsp.

Derivatio nominis: from one of the places of occurrence (Pere).

Diagnosis: *Azonotrilete miosporae.* The equatorial contour is triangular, with straight or weakly convex sides. A differentially thickened spore-wall, with sculptural elements. The laesura is bounded by a torus-like elevation, the outer sides of which are more or less straight or have a sinuous surface. The distal face is ornamented with rugulate and verrucate elements.

Differential diagnosis: The contact area of the *Trilites (Trilites)* subformgenus is straight, while that of this subfgenus is torus-like from the cristae bounding the laesurae.

1. *Trilites (Pereisporites) minor* nov. fsp. (Plate I, Figs. 11—16).

Derivatio nominis: from the small size of the form.
Holotype (Pl. I, Figs. 11—12): Prep. Bi—104/2: 28,8—104,3.
Locus typicus: Bikol (Gerecse mountains): Barremian.
Statum typicum: grey sandstone, 112,3—114.

Diagnosis: *Azonotrilete miospora.* The equatorial contour is triangular, with straight or weakly convex sides. The laesurae are straight and long, and extend to $^2/_3$ of the equator. The tetrad mark is bordered on two sides by ribs about 4—6 μ broad, of a mildly corrugate ornamentation, which are straight on the side above the laesura. The wall of the spore is very thick, 3—5 μ broad, and ornamented with elevated verrucae. The distal face is covered by five elongated ovate elements. These are about 3—4 μ broad and 4—10 μ long: Maximum size: 33 μ.

(In the other specimens: 32—36 μ.) In certain specimens of the forms classified in this formspecies, the ornamental elements of the distal face may fuse into a corrugate or rugulate sculptural surface arranged in a triangle (Pl. I, Figs. 13—14 and 15—16).

Differential diagnosis: It differs from the forms described above in the presence of torus-like corrugate ribs around the tetrad mark.

Note: One of the characteristics of the Barremian layer-complex of the Bikol borehole, its small form, has so far not occurred in the Bakony material.

2. *Trilites (Pereisporites) kyrtomiformis* nov. fsp. (Plate I, Figs. 17—18).

Derivatio nominis: from the torus-like elevation beside the tetrad mark.
Holotype: Hárskút. Prep. Hk—4, 369/3: 45,4—112,5.
Locus typicus: Hárskút (Bakony mountains): Upper Albian.
Stratum typicum: sandy marl: 183,9—186,9 m.

Diagnosis: *Azonotrilete miospora,* with triangular equatorial contour, and straight and weakly convex sides. The exosporium has a 3—4 μ thick (4—5 μ thick at the apices) strongly sinuous wall, with several scattered elevated verrucae. The wall of the spore is also thickened vertically by 3—4 flat verrucae at the apices. The laesurae are straight, extend to $^2/_3$ of the equator, and are weakly opened out. They are bounded on each of two sides by a torus-like elevation about 3 μ broad and 1 μ high, with by and large a weakly corrugate

surface. The other part of the proximal face consists of barely convex rugulate elements. 3—4 anastomotic corrugate ribs, and broken rugulae, can be found on the distal face. Maximum size: 46 μ (the other specimens: 42—48 μ).

Differential diagnosis: It is distinguished from the other forms by the strong torus-like elevation at the tetrad mark, which is ornamented with scarcely elevated verrucae, and also by the relatively homogeneous nature of the proximal face.

III. Subformgenus: *Trilites (Bikolisporites)* nov. subformgenus

Synonym: *Corrugatisporites* (TH. and PF.) WEYL. and GREIF.

Derivatio nominis: from one of the places of occurrence of forms belonging to the subformgenus (Bikol).

Type of the subfgenus: *Trilites (Bikolisporites) toratus* n. comb.

Diagnosis: *Azonotrilete miosporae,* with triangular or rounded equatorial contours, and weakly convex or straight sides. The spore-wall is covered with irregularly shaped verrucae, which fuse into each other. There may be corrugate ornamented by cristae on both surfaces of the spore, running parallel with the tetrad mark and the equatorial contour on the proximal face.

Differential diagnosis: It is distinguished from the previous two subformgenera by the presence of corrugate laths running on the proximal face, more or less parallel with the equatorial sides and the ribs bordering the Y-mark.

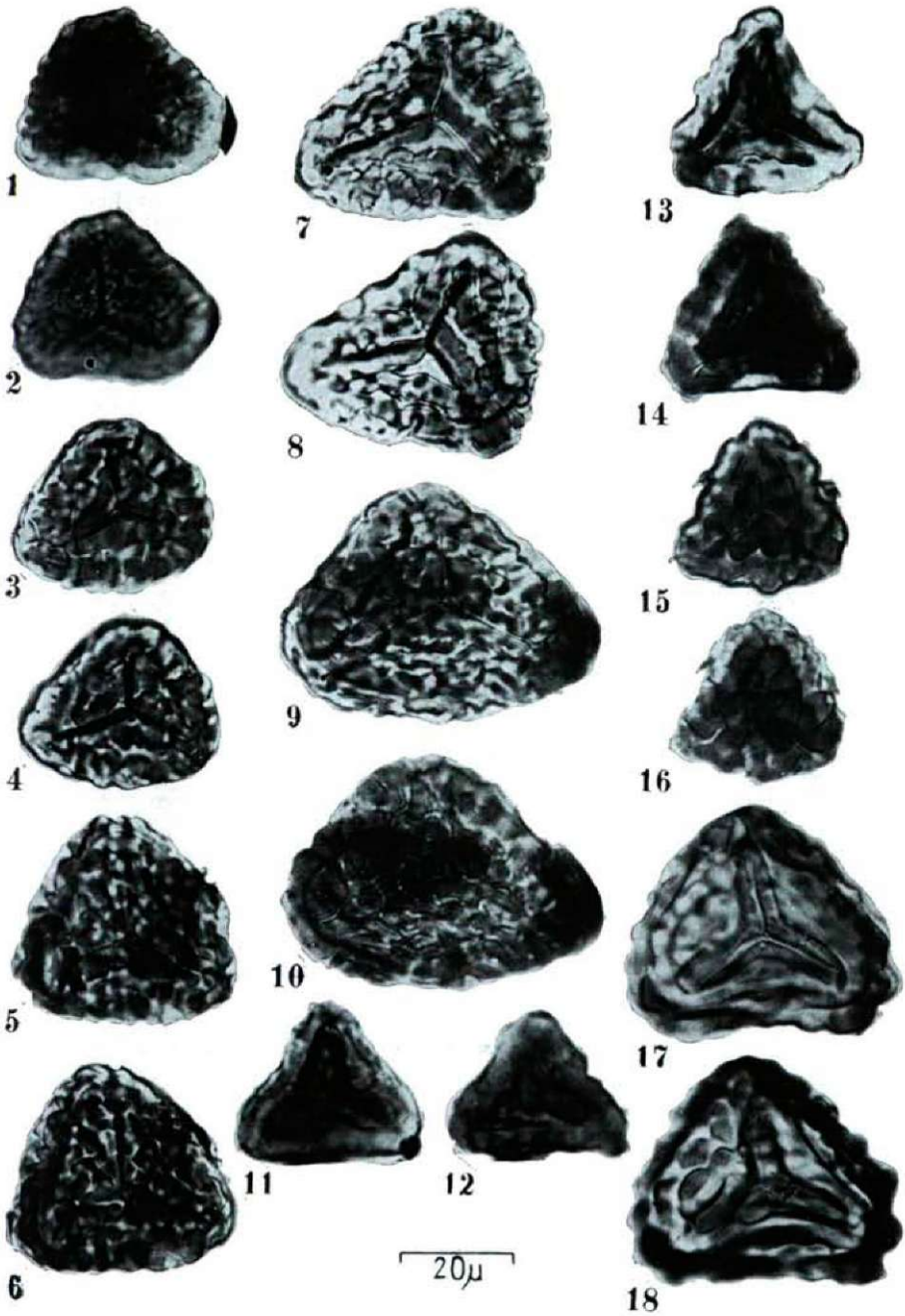
1. fsp.: *Trilites (Bikolisporites) toratus toratus* n. comb. et n. subfsp. (Pl. II, Figs. 1—8).

Syn.: (1953) *Corrugatisporites toratus* WEYL. and GREIF (Pl. II, Figs. 56,57), Quedlinburg: Senonian.
(1966) *Corrugatisporites toratus* WEYL. and GREIF. 1953—GÓCZÁN (in Fülöp) (Pl. VII, Figs. 11, 12), Villány: Albian.
(1968) *Duplexisporites toratus* (WEYL. and GREIF.) PLAYF and DETT. 1965—E. NAGY, Pl. 19, Figs. 1,6.
(1968) *Corrugatisporites toratus* WEYL. and GREIF., -ČORNA (Pl. II, Figs. 1, 2), Slovakia: Albian.

Plate I

1—4. *Trilites (Trilites triangulus* KEDVES 1964.
Figs. 1, 2. Prep. Bi—104/2: 41,1—114. Bikol (Gerecse): Barremian.
Figs. 3, 4. Prep. Bi—106/1: 34—104. Bikol (Gerecse): Barremian.
5, 6. *Trilites (Trilites) asolidus* W. KR. 1959.
Sample Ba—237, Prep. 73/4: 29,7—100,5. Balinka (Bakony): Albian.
7, 8. *Trilites (Trilites) knaueri* n. fsp.
Holotype. Prep. Bi—6/3: 29,5—111,7. Bikol (Gerecse): Barremian.
9, 10. *Trilites (Trilites) hárskútensis* n. fsp.
Holotype. Prep. Bi—6/2: 43—107,2. Bikol (Gerecse): Barremian.
11—16. *Trilites (Pereisporites) minor* n. fsp.
Figs. 11, 12. Holotype. Prep. Bi—104/2: 28,8—104,3.
Figs. 13, 14. Prep. Bi—80/1: 39—106,8.
Figs. 15, 16. Prep. Bi—126/5: 40—111,5.
Bikol (Gerecse): Barremian.
17, 18. *Trilites (Pereisporites) kyrtomiformis* n. fsp.
Holotype. Sample Hk—4, prep. 369/3: 45,4—112,5.
Hárskút (Bakony): Upper Albian.

Plate I



Emended diagnosis: *Azonotrilete miospora.* The equatorial contour is rounded-triangular. The sides are weakly convex or straight lines. The wall of the spore is covered with anastomotic verrucae. The laesura is simple and straight, and extends up to the inner wall of the spore, or a little shorter than this. The laesurae are bounded by ribs running parallel with the Y-mark, which are of corrugate ornamentation from the cristae on them. Each proximal face is also ornamented with a row of regularly running corrugate ribs; these run more or less parallel to the sides of the spore and the ribs bounding the Y-mark, and into the wall of the spore. The course of the ribs here is less directed, and generally 3—4 ribs run out from each apex. Each rib fuses with another two ribs towards the centre of the distal face, or runs towards another apex and unites with another 2 or 3 ribs, leading to a very strong apical thickening with a scabrate surface (see Pl. II, Figs. 5, 6, where the distal course of the ribs can be observed on a spore in a semi-lateral position).

Size: 41—46 μ (in 100 specimens: 36—51 μ).

Occurrence: It is a formspecies which occurs frequently in both the Gerecse and the Bakony layers.

Note: In our opinion the form described by us can be observed in Figures 56, 57 of the form described by WEYLAND and GREIFELD (1953). The *Rotinella trisecta* described by MALJAVKINA (1949) in the Soviet literature also resembles the form reported by us, but according to POTONIÉ (1956) this possesses a cingulum. The form of BOLCHOVITINA (1953) described under the name *Anagramma imperfecta* (MALJ.) n. comb. (Pl. III, Fig. 27) is considered by KRUTZSCH (1959) to be a cingulate form, and he reports it under the name *Polypodiaceoisporites imperfectus.* The 1953 genus was later emended personally by BOLCHOVITINA (1961), who reports completely heterogeneous forms under the name *Anemia imperfecta* (BOLCHOVITINA, 1961, Pl. XV, Fig. 12).

2. fsp. *Trilites (Bikolisporites) toratus baconicus* n. comb. et n. subfsp. (Pl. II, Figs. 9, 10).

From an equatorial view it is rounded, with strongly rounded apices. The wall of the spore is thick (4—5 μ), and fewer, but larger scattered flat verrucae can be found on its surface. The ornamentation of the proximal face and the distal view is similar to that of the previous subfsp.

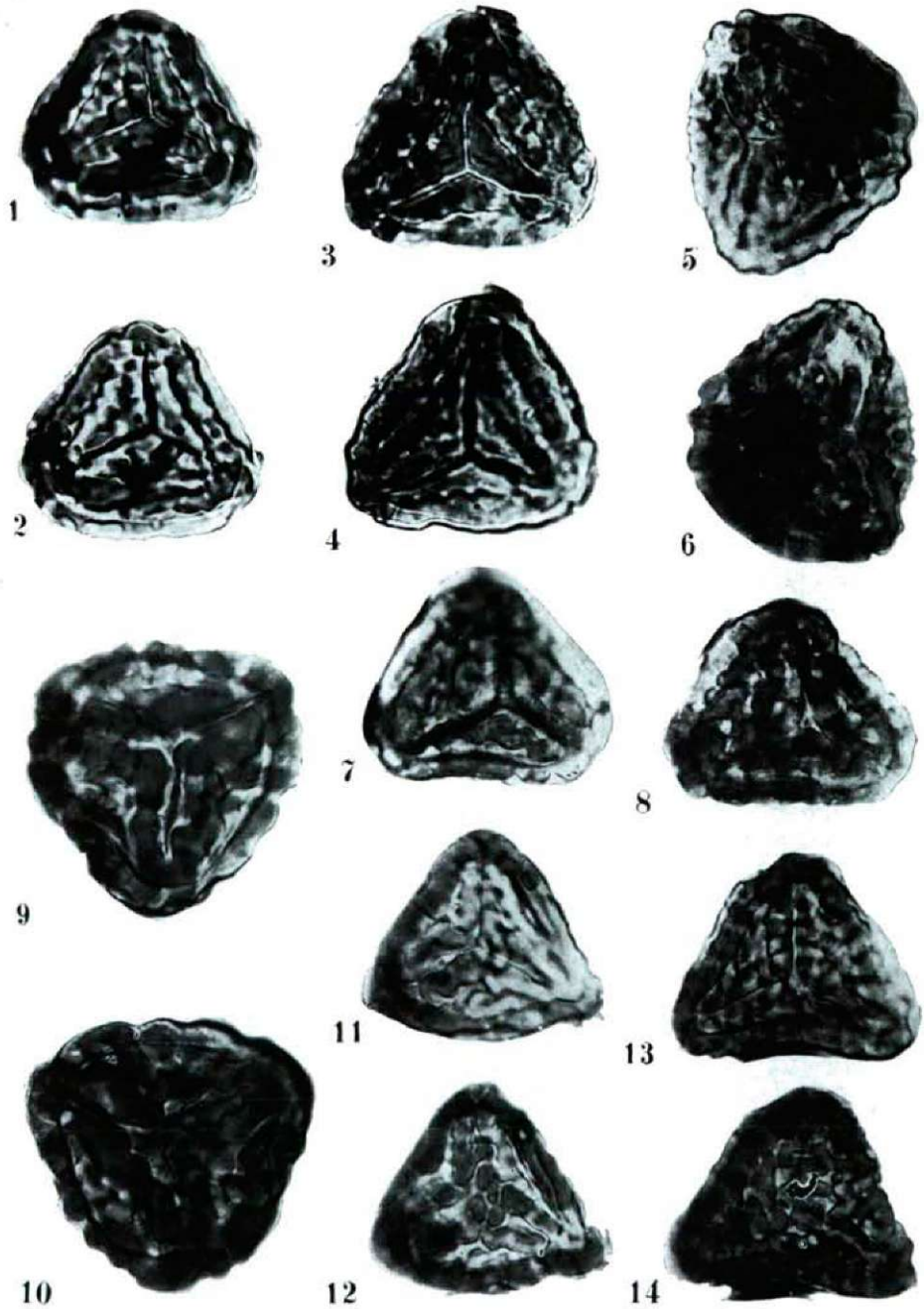
The corrugate ribs of the distal face are broken in each sample.

Size: 52 μ (in 12 specimens: 49—57 μ).

Plate II

1—8. *Trilites (Bikolisporites) toratus toratus* n. comb. et n. subfsp.
Figs. 1—6. Bakony: Albian.
Figs. 1, 2. Sample Ba—237. Prep. 7/1: 38,5—113,4.
Figs. 3, 4. Sample Ba—237. Prep. 22/3: 41—95,8.
Figs. 5, 6. Sample Ba—237. Prep. 24/b: 45,3—110.
Figs. 7, 8. Gerecse: Barremian. Sample Bi—126/4: Prep 41,9—107,2.
9, 10. *Trilites (Bikolisporites) toratus baconicus* n. comb. et n. subfsp.
Bakony: Albian. Sample Hk—4. Prep. 392/2: 14,3—113,8.
11, 12. *Trilites (Bikolisporites) distalrugulatus* n. fsp.
Holotype. Sample Bi—104/2. Prep. 32—107. Gerecse: Barremian.
13, 14. *Trilites (Bikolisporites) transdanubicus* n. fsp.
Holotype. Sample Bi—104/2. Prep. 34,2—108,2. Gerecse: Barremian.

Plate II



Note: It is in general a rarer form occurring in the Bakony borehole samples.

3. *Trilites (Bikolisporites) distalrugulatus* nov. fsp. (Plate II, Figs. 11, 12).

Derivatio nominis: from the rugulate ornamentation of the distal face.

Holotype (Pl. II, Figs, 11, 12): Bi—96/3: 32,0—107,0.

Locus typicus: Bikol (Gerecse mountains).

Stratum typicum: Grey sandstone, 103,0—104,0 m.

Diagnosis: *Azonotrilete miospora,* with triangular, equatorial contour, and with generally straight or weakly convex sides. The wall of the spore is 3—4 μ broad (6—8 μ at the apices). The wall is ornamented with weakly elevated, flattened verrucae. The laesurae are simple, and run up to the wall of the spore. The laesurae are bordered on two sides by ribs with corrugate ornamentation. Between the wall of the spore and the ribs run weakly developed, corrugate laths, which anastomose before the apices of the spore. The extreme elements on the distal face still more or less keep their corrugate ornamentation, but in the centre rugulate elements of various shapes can be found.

Maximum size: 40 μ (in 15 specimens: 37—41 μ).

Differential diagnosis: It is distinguished from the other forms by the rugulate ornamentation of the distal face.

4. *Trilites (Bikolisporites) transdanubicus* nov. fsp. (Plate II, Figs. 13, 14).

Derivatio nominis: from the place of occurrence of the borehole samples containing the spore, taken in a wider sense.

Holotype (Pl. II, Figs. 13, 14): Prep. Bi—104/2: 34,2—108,2.

Locus typicus: Bikol (Gerecse mountans).

Stratum typicum: Grey sandstone, 112,3—114,0 m.

Diagnosis: *Azonotrilete miospora,* with triangular, equatorial contour, and with weakly convex sides. The wall of the spora is thick, dark, and 4—5 μ broad, with strong thickening at the apices. The irregularly elevated verrucae on the wall form a strongly sinuous surface. The laesurae are simple, and run almost up to the wall of the spore. The ribs bordering the laesurae are barely elevated, but the verrucae on them ensure a strongly corrugate surface. The other ornamental element of the proximal face consists of short broken ribs, running parallel to the sides. The rugulae assume a characteristic conformation on the distal face, and so the surface appears „hemireticulate".Maximum size: 45 μ (in 12 specimens: 40—44 μ).

Differential diagnosis: It is distinguished from the other spores by the „hemireticulate" ornamentation of the distal face and the strongly sinuous surface of the proximal face.

Summary

A study was made of the sporomorphae of the Albian layers of „turrilitic marl" from the Bakony and the Barremian grey sandstone from the Gerecse mountains. Trilete fernspores are to be found in an overwhelming majority among these sporomorphae. A dominant role is played by one of these spore-groups, belonging to the Schizaeales order, which on the basis of its characteristic sculptura can be classified in the *Trilites* formgenus.

On the basis of the characteristics of the proximal face of these spores we have created three subformgenera under the names *Trilites (Trilites)* n. subfgen., *Trilites (Pereisporites)* n. subfgen., and *Trilites (Bikolisporites)* n. subfgen. 7 newly described formspecies and 2 subformspecies have been classified in these subgenera.

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